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Review Of "Once We All Had Gills: Growing Up Evolutionist In An Evolving World" By R. A. Raff

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REVIEW

Once We All Had Gills: Growing Up Evolutionist in an Evolving World

by Rudolf A Raff
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reviewed by Scott F Gilbert

To take a stroll with Rudy Raff is to see the Ordovician in a roadside outcrop and to have current events refracted through the mind of a brilliant interpreter of nature's greatest stories. So it is well worth while to read this book for many reasons. One is to read of a life, a life in science, well lived. But this is not only an autobiography of Rudolf Raff; it is a biography of contemporary embryology and how it, too, has changed during the past half-century. Moreover, this is a book about natural history as path to science. Raff can't help being a teacher, and we learn about the phylogeny of Australian velvet worms and platypuses, the formation of the earth and moon, the predatory habits of dragonfly larvae, and even the mechanism by which a male butterfly knows that it has successfully docked with a female. We learn how embryos can be fossilized and how "Jesus lizards" run upon the water. And throughout the book, Raff muses on the different ways of becoming a scientist and how the naturalist–scientist is becoming as endangered as the world he or she would study.

There are, I believe, three reciprocally interacting stories being discussed here. The first is the development of a scientist from curious lad to keynote speaker. Raff starts his book like the beginning of one of James Michener's novels, with the geology of his birthplace. One cannot understand the development of an organism without appreciating its environmental context. As the scientist matures, he enters and is influenced by other contexts, including Mexico, America during the Vietnam War and Civil Rights movement, the Marine Biology Laboratory at Woods Hole, the shores of Australia, and the plains of Indiana. Family matters matter, and this "autobiography" often becomes a group biography of other family members. We co-evolve and co-develop.

The second story is the development of modern embryology from a descriptive adjunct to anatomy to its position in the center of contemporary molecular biology, with its importance in regeneration, stem cells, epigenetic disease, and the origins and maintenance of biodiversity. Here, Raff played a central role. He was the first to identify a messenger RNA stored in the sea urchin egg, and this discovery was one of a group of investigations that led to the molecularization of embryology into developmental genetics. Later, Raff would provide many of the conceptual foundations, as well as some of the early data, for integrating such molecular (and non-molecular) developmental biology with paleontology and evolutionary theory into the first iteration of evolutionary developmental biology (evo-devo). The role of the Marine Biology Laboratory at Woods Hole in nurturing these types of interactions and seeing the connections between the old embryology and the new em-

bryology is critical. Raff is very good at showing several different and good mentor-student relationships that are possible for scientific maturation. Some of these mentors (such as Paul Gross, George Beatty, and Alice Beatty) are wonderful characters, and they each had a different mode of teaching. No one size fits all.

The third story concerns the degradation of the earth and of the wonder that is the initiator of science. As William Souder recently wrote in his biography of Rachel Carson, the history of American environmentalism is a history of nature and science pitted against industry and its governmental representatives. Raff is a scientist fighting to preserve the wonder that initiates the attitudes and questions upon which science depends. Raff celebrates the world's biodiversity as only a field naturalist and paleontologist can. He sees not only the interactions of our contemporary flora, fauna, and microbiota, but also those from the Precambrian to the present. Raff's vision is in five dimensions, with deep time being an inescapable context for the four dimensions of animal development. Just as certain birds and bees can see in the ultraviolet or infrared regions of the spectrum, Raff sees the temporal as well as spatial dimensions of biodiversity. This ability has framed not only his life but also the discipline of evolutionary developmental biology. It is truly a "vision."

The readers of this journal, however, might view all this as a prelude to the last three chapters that deal with the creationist challenge to biology and with the importance of evolution to human concerns. Indeed, the book is, not surprisingly, given its subject and author, an evolution text in autobiographical form. The threads of paleontology, natural history, evolutionary biology, and developmental biology that are introduced independently within the book become woven together as evolutionary developmental biology. Moreover, at the same time he discusses the scientific importance of this new field, he also looks at the need for such knowledge to do nothing less than save humankind from being its own executioner. This last section of the book is a well-documented brief for the teaching of evolutionary biology and for the recognition of creationism and "intelligent design" as thinly disguised and rather poor theologies. Many of the readers of this journal will know this material, but Raff summarizes it beautifully and puts it in his own particular context.

The last chapter of *Once We All Had Gills* is a *tour de force* summary of the importance of evolutionary thinking for the ideas and practices of sustainability. Here, Raff brings together evolutionary biology and sustainability issues in an important way. We have evolved a brain that can plan, and in so doing, can imagine things that never were nor will ever be. We have evolved a brain that can fool itself into believing that which we know isn't real. Raff politely, but urgently, uses facts and data to puncture the fantasies and delusions that allow the destruction of the planet. Raff argues that we are causing evolutionary trends that will, if left unabated, result in the extinction of entire clades of species, probably including the genus *Homo*. We have already caused parts of the ocean to resemble the Cambrian ecosystem with its giant jellyfish; and the dead zones of the Atlantic push the oceanic ecosystem toward the Archaean Eon. Evolutionary biology becomes not just a theory, but also a worldview vital to the survival of our species and much of contemporary nature.

About the author

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